

Fraction Face-Off!

Intervention Report | Primary Mathematics Topic Area

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Understanding fractions is a critical skill for success in school and the workforce, and is often necessary for daily life tasks like distributing work or cooking a meal.¹ Fractions are also an important precursor to other math courses, such as algebra. *Fraction Face-Off!* is a supplemental math program designed to support fourth-grade students who need assistance solving fraction problems. Teachers use program materials with individual students or small groups to promote understanding of the magnitude of fractions, to compare two fractions, to put three fractions in order, and to place fractions on a number line. The program includes 36 lessons, each with four activities: a warm-up problem, group work, a speed game to build fluency, and a worksheet to check

students' understanding. These lessons are designed to be taught three times a week for 12 weeks.²

This What Works Clearinghouse (WWC) report, part of the WWC's Primary Mathematics topic area, explores the effects of *Fraction Face-Off!* on mathematics outcome domains including geometry and measurement, number and operations, and general mathematics achievement. The WWC identified one study of *Fraction Face-Off!*, which meets WWC standards. The evidence presented in this report is from one study of the impact of *Fraction Face-Off!* on a racially and ethnically diverse group of fourth-grade students.

What Happens When Students Participate in *Fraction Face-Off!*?³

The evidence indicates that implementing *Fraction Face-Off!*:

- **May increase student achievement in geometry and measurement**
- **May increase student achievement in number and operations**
- **May increase student achievement in general mathematics achievement**

Findings on *Fraction Face-Off!* from one study that meets WWC standards are shown in Table 1. For each outcome reviewed by the WWC, an effectiveness rating, the improvement index, and the number of studies and students that contributed to the findings are presented. The improvement index is a measure of the intervention's effect on an outcome. It can be interpreted as the expected change in percentile rank for an average comparison group student if that student had received the intervention.

Table 1. Summary of findings on *Fraction Face-Off!* from one study that meets WWC Standards

Outcome domain	Effectiveness rating	Study Findings		Evidence meeting WWC standards (version 4.0)	
		Improvement index (percentile points)	Number of studies	Number of students	
Geometry and measurement	Potentially positive effects	+33	1	212	
Number and operations	Potentially positive effects	+31	1	1,152	
General mathematics achievement	Potentially positive effects	+24	1	1,152	

Note: The improvement index can be interpreted as the expected change in percentile rank for an average comparison group student if that student had received the intervention. For example, an improvement index of +33 means that the expected percentile rank of the average comparison group student would increase by 33 points if the student received *Fraction Face-Off!*. The improvement index values are generated by averaging findings from the outcome analyses that meet WWC standards, as reported by Fuchs et al. (2013). The outcomes in the geometry and measurement domain were only examined in one of the five student cohorts examined in the study and therefore are based on fewer students than the analyses in the number and operations and general mathematics achievement domains. Geometry and measurement outcomes reported in the study include two researcher-designed measures: 1) a fraction magnitude comparison test and 2) a fraction magnitude explanation test. Number and operations outcomes reported in the study include six researcher-designed measures: 1) a test of comparing and representing fractions; 2) a fraction number line test; 3) a test of fraction calculations; 4) a test of word problems requiring multiplication; 5) a test of word problems requiring addition; and 6) a test of word problems requiring fractions. General mathematics achievement outcomes reported in the study include a collection of selected items from the National Assessment of Educational Progress (NAEP). The effects of *Fraction Face-Off!* are not known for other outcomes within the Primary Mathematics topic area, including data analysis, statistics, and probability, and algebra.

BOX 1. HOW THE WWC REVIEWS AND DESCRIBES EVIDENCE

The WWC evaluates evidence based on the quality and results of reviewed studies. The criteria the WWC uses for evaluating evidence are defined in the [Procedures and Standards Handbooks](#) and the [Review Protocols](#). The studies summarized in this report were reviewed under WWC Standards (version 4.0) and the Primary Mathematics topic area protocol (version 4.0).

To determine the effectiveness rating, the WWC considers what methods each study used, the direction of the effects, and the number of studies that tested the intervention. The higher the effectiveness rating, the more certain the WWC is about the reported results and about what will happen if the same intervention is implemented again. The following key explains the relationship between effectiveness ratings and the statements used in this report:

Effectiveness Rating	Rating interpretation	Description of the evidence
Positive (or negative) effects	The intervention is <i>likely</i> to change an outcome	Strong evidence of a positive effect, with no overriding contrary evidence
Potentially positive (or negative) effects	The intervention <i>may</i> change an outcome	Evidence of a positive effect with no overriding contrary evidence
No discernible effects	The intervention <i>may result in little to no change</i> in an outcome	No affirmative evidence of effects
Mixed effects	The intervention <i>has inconsistent effects</i> on an outcome	Evidence includes studies in at least two of these categories: studies with positive effects, studies with negative effects, or more studies with indeterminate effects than with positive or negative effects

How is *Fraction Face-Off!* Implemented?

The following section provides details of how *Fraction Face-Off!* was implemented. This information can help educators identify the requirements for implementing *Fraction Face-Off!* and determine whether implementing this program would be feasible in their district or school. Information on *Fraction Face-Off!* presented in this section comes from the one study that meets WWC standards (Fuchs et al., 2013) and from correspondence with the developer.

- **Goal:** *Fraction Face-Off!* aims to support students who need assistance solving fractions.
- **Target population:** *Fraction Face-Off!* is designed for fourth-grade students who have demonstrated difficulty in mathematics.
- **Method of delivery:** Classroom educators, including teachers and paraprofessionals, can deliver *Fraction Face-Off!* to individual students or in small-group settings. The *Fraction Face-Off!* program materials refer to the classroom educator who delivers *Fraction Face-Off!* as a tutor.

Comparison group: In the study that contributes to this intervention report, the first cohort of students in the comparison group used the regular district curriculum: Houghton Mifflin Math. Later cohorts used a different curriculum: enVisionMATH.

- **Frequency and duration of service:** The developer recommends students use *Fraction Face-Off!* three times a week for 12 weeks for about 30 minutes per session. It is typically used during class time or during a pull-out time to supplement the math curriculum.
- **Intervention components:** *Fraction Face-Off!* includes a teacher's guide and student worksheets for each lesson. An optional Implementation Ready Pack provides materials that teachers would otherwise have to prepare themselves, such as flashcards and manipulatives. The current version of *Fraction Face-Off!* is the 2015 Revised Edition.⁴ Refer to Table 2 for additional details.

Table 2. Components of *Fraction Face-Off!*

Key component	Description
Group size	<i>Fraction Face-Off!</i> is designed for use with individual students or small groups of up to three students.
Content	<i>Fraction Face-Off!</i> includes 36 lessons delivered over the course of 12 weeks, with each week focusing on specific concepts and skills. The first two weeks of instruction typically focus on building fraction foundations by introducing key vocabulary, such as numerator, denominator, unit; describing the meaning of fractions as one or more equal parts of a single object; and comparing two fractions in which the numerator or denominator are the same. In weeks 3–5, the focus shifts to understanding magnitude reasoning, building fluency with the meaning of fractions, correctly ordering two fractions on a number line spanning 0 to 1, and understanding word problems that require multiplication and addition with fractions. Concepts covered in weeks 6 and 7 include improper fractions, fractions equivalence, placing fractions on a number line spanning 0 to 1, comparing two fractions in which the numerator and denominator both differ, and ordering three fractions from largest to smallest. In weeks 8 and 9, students focus on fraction addition and subtraction. In weeks 10 to 12, there is a cumulative review of all fraction concepts including part–whole concept and measurement interpretations of fractions.
Activities	Each lesson includes four activities: a warm-up word problem, group work during which the teacher demonstrates fraction concepts using explicit instruction, a speed game to build fluency, and a worksheet activity that students complete individually to check their understanding of the fraction concepts. The program involves frequent use of fluency practice using speed tests or flashcards, and conceptual practice requiring students to explain their reasoning about fractions to the group. The program includes ongoing assessment through daily worksheets and a cumulative review during the final three lessons. The program has embedded motivation through a sports theme and a football challenge at the end of the program.
Recommended dosage	The developer recommends three 30- to 35-minute lessons per week for 12 weeks.
Training	<i>Fraction Face-Off!</i> includes up to a week of training for teachers before delivering content to students. In the training workshop, the trainer presents an overview of the program goals and procedures. Procedures are then modeled and practiced for each activity in the first set of topics. Teachers have opportunities to practice techniques and activities in pairs and receive feedback. Once teachers begin delivering <i>Fraction Face-Off!</i> , they attend 1-hour meetings every other week to provide feedback and help solve problems related to any challenges present in the class. Teachers may be certified teachers or paraprofessionals.

What Does *Fraction Face-Off!* Cost?

This preliminary list of costs is not designed to be exhaustive; rather, it provides educators with an overview of the major resources needed to implement *Fraction Face-Off!*. The program costs described below are based on the information available as of August 2019.

- **Equipment and materials costs:** *Fraction Face-Off!* includes a teacher's manual (\$40), which provides teachers with all information necessary for implementation and includes supplemental materials in paper format, including worksheets, flashcards, and templates for manipulatives. Alternative formats of the manual are also available on CD or USB flash drive (\$40 each). There is an optional 1-year license (\$10) or a license in perpetuity (\$30). In addition, teachers can purchase manipulatives, including greater-than/less-than cards, flash cards, and a spinner and game wheel for in-class activities, for 12 students (\$50).
- **Personnel costs:** Classroom educators, including teachers and paraprofessionals, can deliver *Fraction Face-Off!*. Before implementing *Fraction Face-Off!*, teachers may

attend up to a week of initial training at their school. An experienced trainer from Vanderbilt University offers the training; training costs range from \$1,500 to \$1,800 plus travel expenses for the trainer.

- **Facilities costs:** Schools will need to make copies of materials and provide manipulatives for all participating students. The developer recommends that teachers laminate materials for reuse. If the intervention is not implemented in the student's regular classroom, schools must provide classroom space.
- **Costs paid by students or parents:** Students and their parents do not pay to access *Fraction Face-Off!*.
- **In-kind supports:** No information is available.
- **Sources of funding:** School districts or schools usually purchase *Fraction Face-Off!* and pay for the teacher training costs.

For More Information:

About *Fraction Face-Off!*

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About the cost of the intervention

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Research Summary

The WWC identified one study that investigated the effectiveness of *Fraction Face-Off!* (Figure 1):

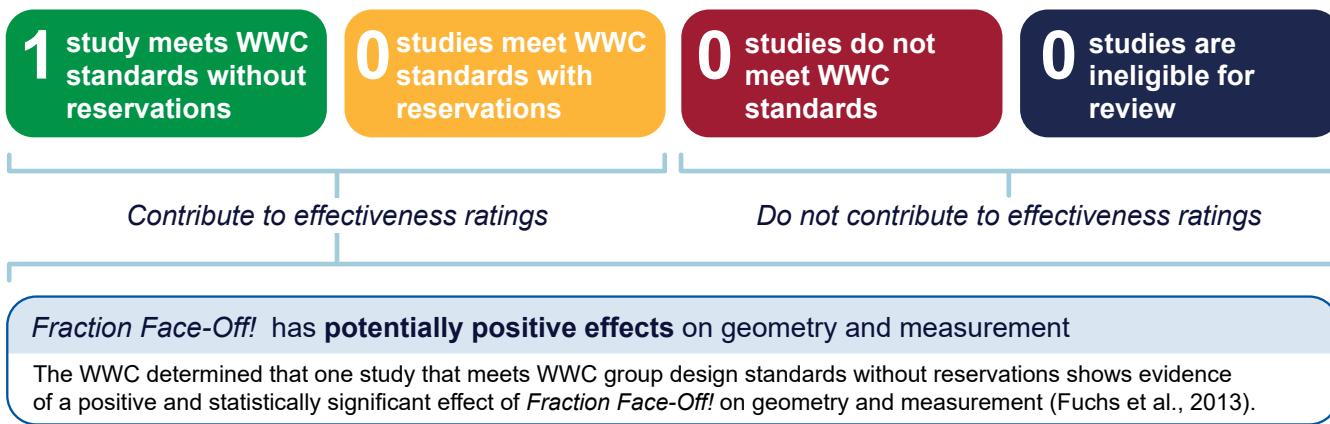
- One study meets WWC group design standards without reservations

The WWC reviews findings on the intervention's effects on eligible outcome domains from studies that meet standards, either with or without reservations. Based on this review, the WWC generates an effectiveness rating, which summarizes how the intervention impacts, or changes, a particular outcome domain. The WWC reports additional supplemental findings, such as those the study authors reported separately by cohort, on the WWC website (<https://whatworks.ed.gov>).

These supplemental findings and findings from studies that either do not meet WWC standards or are ineligible for review do not contribute to the effectiveness ratings.

The one study of *Fraction Face-Off!* that meets WWC group design standards reported findings on geometry and measurement, number and operations, and general mathematics achievement. This study did not report findings on the following two outcome domains in the Primary Mathematics topic area: data analysis, statistics, and probability; and algebra. Citations for the one study reviewed for this report are listed in the References section, which begins on page 9.

Figure 1. Effectiveness ratings for *Fraction Face-Off!*



Fraction Face-Off! has potentially positive effects on geometry and measurement

The WWC determined that one study that meets WWC group design standards without reservations shows evidence of a positive and statistically significant effect of *Fraction Face-Off!* on geometry and measurement (Fuchs et al., 2013).

Fraction Face-Off! has potentially positive effects on number and operations

The WWC determined that one study that meets WWC group design standards without reservations shows evidence of a positive and statistically significant effect of *Fraction Face-Off!* on number and operations (Fuchs et al., 2013).

Fraction Face-Off! has potentially positive effects on general mathematics achievement

The WWC determined that one study that meets WWC group design standards without reservations shows evidence of a positive and statistically significant effect of *Fraction Face-Off!* on general mathematics achievement (Fuchs et al., 2013).

Main Findings

Table 3 shows the findings from the one *Fraction Face-Off!* study that meets WWC standards. The table includes WWC calculations of the mean difference, effect size, and performance of the intervention group relative to the comparison group. Based on findings from the one study that meets WWC standards, the effectiveness ratings for geometry and

measurement, number and operations, and general mathematics achievement are *potentially positive effects*, indicating strong evidence of a positive effect, with no overriding contrary evidence. These findings are based on 212, 1,152, and 1,152 students, respectively.

Table 3. Findings from study of *Fraction Face-Off!* by outcome domain

Measure (study)	Study sample	Sample size	Mean (standard deviation)		WWC calculations			
			Intervention group	Comparison group	Mean difference	Effect size	Improvement index	p-value
<i>Fraction magnitude comparison</i>	Fourth-grade students	212	6.21 (1.26)	4.59 (1.65)	1.62	1.15	+38	< .01
<i>Fraction magnitude explanation</i>	Fourth-grade students	212	6.10 (7.81)	1.14 (2.09)	4.96	0.76	+28	< .01
Outcome average for geometry and measurement (Fuchs et al., 2013)^a						0.96	+33	Statistically significant
Compare fractions	Fourth-grade students	259	8.41 (3.37)	7.06 (2.84)	1.34	0.43	+17	< .01
Multiplicative word problems	Fourth-grade students	425	10.35 (6.57)	6.93 (5.06)	3.42	0.56	+21	< .01
Fraction number line	Fourth-grade students	1,152	0.23 (0.13)	0.33 (0.14)	-0.10	0.75	+27	< .01
Fraction calculation	Fourth-grade students	1,152	19.30 (7.08)	8.68 (4.75)	10.62	1.68	+45	< .01
Additive word problems	Fourth-grade students	213	14.48 (6.20)	7.94 (3.86)	6.54	1.18	+38	< .01
Fraction word problems	Fourth-grade students	225	11.51 (3.78)	8.79 (3.70)	2.72	0.72	+26	< .01
Outcome average for number and operations (Fuchs et al., 2013)^a						0.89	+31	Statistically significant
National Assessment of Educational Progress (NAEP) selected items	Fourth-grade students	1,152	14.83 (3.87)	12.36 (3.90)	2.47	0.64	+24	< .01
Outcome average for general mathematics achievement (Fuchs et al., 2013)^a						0.64	+24	Statistically significant

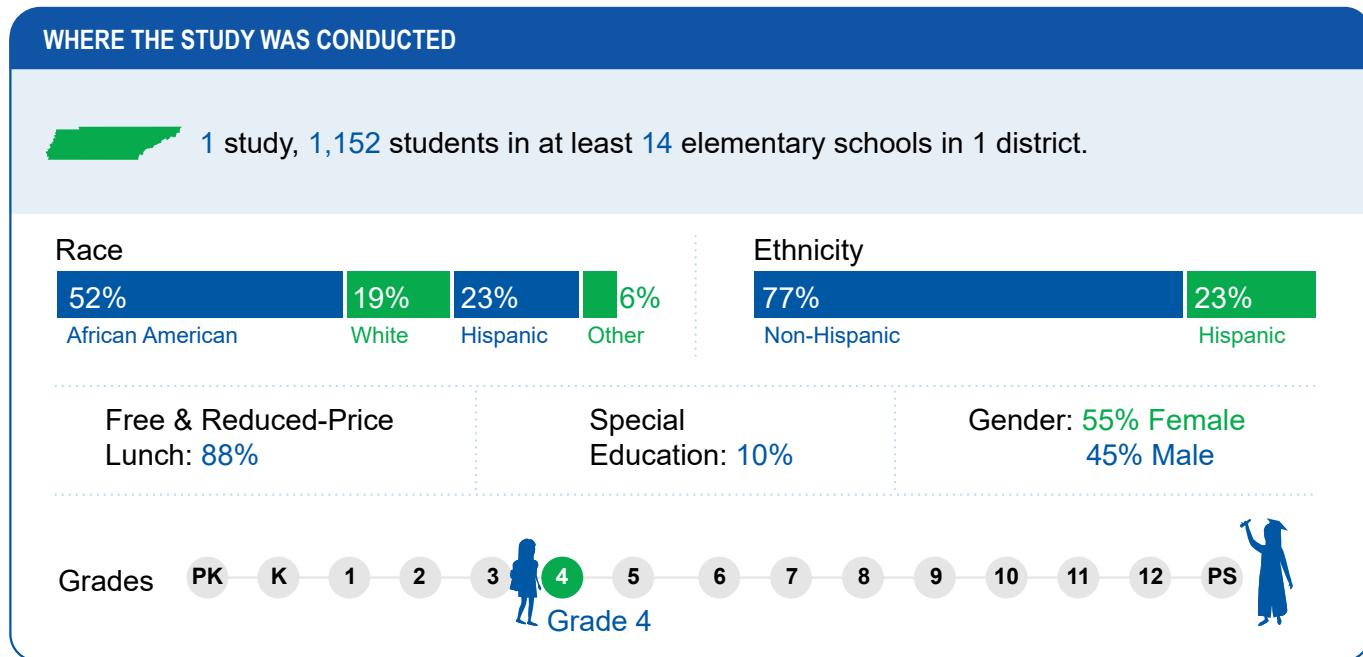
Notes: For most mean difference and effect size values reported in the table, a positive number favors the intervention group and a negative number favors the comparison group. This is not true for fraction number line, where lower mean scores indicate more favorable results; the WWC effect size and improvement index reported in the table are adjusted so that a positive number favors the intervention group. The effect size is a standardized measure of the effect of an intervention on outcomes, representing the average change expected for all individuals who are given the intervention (measured in standard deviations of the outcome measure). An indicator of the effect of the intervention, the improvement index can be interpreted as the expected change in percentile rank for an average comparison group student if that student had received the intervention. For example, an improvement index of +33 means that the expected percentile rank of the average comparison group student would increase by 33 points if the student received *Fraction Face-Off!* Some statistics might not sum as expected due to rounding.

^a Fuchs et al. (2013) did not require corrections for clustering or difference-in-differences adjustments. The WWC-calculated effect sizes and p-values presented here for the following outcomes are combined across findings for individual student cohorts reported on separately in the study: fraction magnitude comparison, fraction magnitude explanation, multiplicative word problems, fraction number line, fraction calculation, additive word problems, fraction word problems, and researcher-selected items from the NAEP. This study is characterized as having a statistically significant positive effect on geometry and measurement, number and operations, and general mathematics achievement because the average estimated effect across outcomes in these domains is positive and statistically significant. For more information, refer to the WWC Procedures Handbook, version 4.0, page 22.

In What Context Was *Fraction Face-Off!* Studied?

The following section provides information on the setting of the one study of *Fraction Face-Off!* that meets WWC standards, and a description of the participants in the research.⁵ This

information can help educators understand the context in which the study of *Fraction Face-Off!* was conducted, and determine whether the program might be suitable for their setting.



Details of Each Study that Meets WWC Standards

This section presents details for the study of *Fraction Face-Off!* that meets WWC standards. These details include the full study reference, findings description, findings summary, and description of study characteristics. A summary of domain findings for the study is presented below, followed by a description of the study characteristics. These study-level details include contextual information around the study setting, methods, sample, intervention group, comparison group, outcomes, and implementation details. For additional information, readers should refer to the original study.

Research details for Fuchs et al. (2013)

Fuchs, L. S., Schumacher, R. F., Long, J., Namkung, J., Hamlett, C. L., Cirino, P. T., ... Changas, P. (2013). Improving

at-risk learner's understanding of fractions. *Journal of Educational Psychology*, 105(3), 683–700. Retrieved from <https://eric.ed.gov/?id=EJ1054396>

Findings from Fuchs et al. (2013) show evidence of potentially positive effects of *Fraction Face-Off!* in the geometry and measurement, number and operations, and general mathematics achievement domains (Table 4). These findings are based on outcome analyses that includes 212, 1,152, and 1,152 students, respectively. The findings and research details summarized for this study come from eight related citations, including the primary citation above.⁶ See the References section, which begins on page 9, for a list of all related publications.

Table 4. Summary of findings from Fuchs et al. (2013)

Outcome domain	Sample size	Meets WWC Group Design Standards Without Reservations		
		Study findings		
Geometry and measurement	212 students	0.96	+33	Yes
Number and operations	1,152 students	0.89	+31	Yes
General mathematics achievement	1,152 students	0.64	+24	Yes

Table 5. Description of study characteristics for Fuchs et al. (2013)

WWC evidence rating	Meets WWC Group Design Standards Without Reservations. This is a randomized controlled trial (RCT) with low attrition. For more information on how the WWC assigns study ratings, please see the WWC Procedures and Standards Handbooks (version 4.0) and WWC Standards Briefs , available on the WWC website.
Setting	The study took place in multiple classrooms and schools within a single school district over a 5-year period. Each year of the study, the study involved a new cohort of approximately 250 fourth-grade students from 50 classrooms in 14 elementary schools. The location of the schools was not specified.
Methods	The study authors randomly assigned fourth-grade students to either a comparison group or to one or two intervention groups. Random assignment occurred separately for each of five successive cohorts of students. Students in the first cohort were assigned to either the comparison group or a <i>Fraction Face-Off!</i> intervention group, while students in the other four cohorts were assigned to the comparison group or one of two intervention groups, both of which used <i>Fraction Face-Off!</i> . Both of these intervention groups were considered eligible implementations of <i>Fraction Face-Off!</i> for this WWC review. ⁷ The sample loss after random assignment (attrition) was within the acceptable threshold for the review: the overall attrition rate was between 5% and 13%, and differential attrition rate was between 0 and 8 percentage points.
Study sample	Study students were fourth-grade students considered at-risk in mathematics, which the authors defined as scoring below the 35th percentile on a computation test. Among students who met the definition of at-risk within study classrooms, the authors sampled three to nine students per class for inclusion in the study. Averaging across the five student cohorts, approximately 52% of students were African American, 19% were White, 23% were Hispanic, and 6% were another race or ethnicity. Approximately 55% of students were female, 15% were English learners, 88% were eligible for free or reduced-price lunch, and 10% were in special education classrooms.
Intervention group	Within each study class, the <i>Fraction Face-Off!</i> intervention was delivered by one teacher to small groups (three-to-one ratio) three times per week for 12 weeks between September/October and early February. Each teacher was responsible for two to four groups. Depending on each regular classroom teacher's scheduling preference, the teacher delivered the intervention to the study students through pull-out tutoring sessions that took place during one of the three school instructional periods: 1) students' math block (typically 50 minutes), 2) math center time (typically 20 minutes), or 3) the school's intervention period (typically 45 minutes). Study teachers were graduate students funded by the research grant; some were licensed teachers, but most were not licensed. Each of the 36 lessons varied in length between 30 and 35 minutes, and included four to six activities. In year 1, there was one intervention group, and each lesson included four activities: introduction of concepts or skills (8–12 minutes), group work (8–12 minutes), the speed game (1 minute), and individual work (8 minutes). In years 2 through 5, when there were two <i>Fraction Face-Off!</i> intervention groups, 25 minutes of each session were the same across the two intervention conditions. Instructional methods differed for the remaining 5 to 7 minutes of each session. For year 2, the activities for 5 minutes of each session differed between the two intervention conditions; students either completed activities to build fluency with measurement topics or they completed activities to consolidate conceptual understanding of the same measurement topics. In year 3, the activities for 7 minutes of each session differed between groups; one intervention condition focused on multiplicative word problems, while the other intervention condition focused on additive word problems. In year 4, the activities for 7 minutes of each session differed, during which teachers taught students to provide high quality explanations when comparing fraction magnitudes or solve fraction word problems. In year 5, the 7-minute warm-up activity differed between the two intervention conditions, during which teachers implemented the decimal magnitude or fraction applications component. In addition to <i>Fraction Face-Off!</i> , students in the intervention group also used their regular district math curriculum, Houghton Mifflin Math (Greenes et al., 2005) in year 1 and enVisionMATH (Scott Foresman-Addison Wesley, 2011) in years 2 through 5.
Comparison group	The comparison group used the regular district curriculum, Houghton Mifflin Math in year 1 and enVisionMATH in years 2 through 5. Houghton Mifflin Math included lessons on conceptual understanding and procedural calculations and focused on understanding parts of a whole. The conceptual lessons included vocabulary instruction, connections across multiple curricula (including social studies, music, and writing), guided practice, independent work, and connections to real life. The procedural calculations included calculations with proper and improper fractions and mixed numbers. The enVisionMATH curriculum included two units: 1) Understanding Fractions, and 2) Adding and Subtracting Fractions. The Understanding Fractions unit focused on understanding parts of a whole by using manipulatives and drawings to illustrate the concept, and the Adding and Subtracting Fractions unit focused on procedures with fractions. The delivery of the enVisionMATH curriculum in the comparison condition covered some more advanced topics than its delivery in the intervention condition and did not restrict the range of denominators, whereas the intervention conditions limited the range of denominators to 2, 3, 4, 5, 6, 8, 10, and 12 and the range of equivalent fractions and reducing activities to 1/2, 1/3, 1/4, 1/5, and 1/1.

Outcomes and measurement	<p>Study authors reported findings on 10 outcome measures, all of which were researcher-designed tests and are eligible for review under the Primary Mathematics topic area. Nine of the 10 outcomes met WWC validity and reliability requirements and have findings that meet WWC group design standards and are presented in this report. Two of the nine outcomes focus on measurement and fall within the geometry and measurement domain: 1) a fraction magnitude comparison test in which students must place the greater-than or less-than symbol between fractions and write or illustrate pictures to explain why the fractions differ; and 2) a fraction magnitude explanation test that assesses the quality of explanations of fraction magnitude.</p> <p>Six of the nine outcomes are in the number and operations domain: 1) a test of comparing fractions that assesses students' understanding of magnitude using two fractions that students write the greater-than, less-than, or equal-to sign between; 2) a test of multiplicative word problems that requires students to make fractions from units (the "splitting" problem type), make units from fractions (the "grouping" problem type), and compare fraction quantities; 3) a test of fraction number lines in which students place proper fractions, improper fractions, and mixed numbers on a number line with endpoints labeled 0 and 2 (scores are the absolute difference between the placement of the fraction and the correct position of the number, where lower scores indicate more favorable results); 4) a test of fraction calculations that includes addition and subtraction problems with like and unlike denominators; 5) a test of additive word problems that focuses on change, increasing, decreasing, and comparing fractions; 6) a test of fraction word problems that focuses on change, increasing, and decreasing fractions.</p> <p>One of the nine outcomes is in the general mathematics achievement domain: a collection of 19 researcher-selected items from the 1990–2009 NAEP fourth-grade assessment that included items on interpreting parts and the whole, interpreting measurement, subtracting fractions, and determining how many fourths make a whole.</p> <p>All nine outcomes were measured in the spring after the intervention had been offered in the fall.</p> <p>The study also reported findings for a very low performing subsample of students for cohorts 1 through 3 as well as those findings for each of the two variations of the treatment in cohorts 2 through 5. Summaries of these findings are available on the WWC website (https://whatworks.ed.gov). The supplemental findings do not factor into the intervention's rating of effectiveness.</p>
Additional implementation details	<p>The study teachers were full- or part-time graduate student employees of the research grant and included some licensed teachers. They were trained by experienced <i>Fraction Face-Off!</i> professional staff through a weeklong initial workshop followed by 1-hour follow-up trainings every other week. Follow-up trainings provided teachers with feedback and included problem solving about students' challenging behavior and skill-level differences. Teachers received lesson guides for each of the 36 lessons and were expected to review, but not memorize, the guides. Before implementation, teachers practiced delivering the lesson to other teachers.</p>

References

Study that meets WWC group design standards without reservations

Fuchs, L. S., Schumacher, R. F., Long, J., Namkung, J., Hamlett, C. L., Cirino, P. T., ... Changas, P. (2013). Improving at-risk learner's understanding of fractions. *Journal of Educational Psychology, 105*(3), 683–700. Retrieved from <https://eric.ed.gov/?id=EJ1054396>

Additional sources:

Fuchs, L. S., Fuchs, D., Compton, D. L., Wehby, J., Schumacher, R. F., Gersten, R., & Jordan, N. C. (2015). Inclusion versus specialized intervention for very-low-performing students: What does access mean in an era of academic challenge? *Exceptional Children, 81*(2), 134–157. Retrieved from <https://eric.ed.gov/?id=ED552925>

Fuchs, L. S., Malone, A. S., Schumacher, R. F., Namkung, J., Hamlett, C. L., Jordan, N. C., ... Changas, P. (2016). Supported self-explaining during fraction intervention. *Journal of Educational Psychology, 108*(4), 493–508. Retrieved from <https://eric.ed.gov/?id=EJ1099301>

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Fuchs, L. S., Schumacher, R., Sterba, S., Long, J., Namkung, J., Malone, A., ... Changas, P. (2014). Does working memory moderate the effects of fraction intervention? An aptitude-treatment interaction. *Journal of Educational Psychology, 106*(2), 499–514. Retrieved from <https://eric.ed.gov/?id=ED552820>

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Fuchs, L. S., Sterba, S. K., Fuchs, D., & Malone, A. S. (2016). Does evidence-based fractions intervention address the needs of very low-performing students? *Journal of Research on Educational Effectiveness, 9*(4), 662–677. Retrieved from <https://eric.ed.gov/?id=EJ1115270>

Malone, A. S., Fuchs, L. S., Sterba, S. K., Fuchs, D., & Foreman-Murray, L. (2019). Does an integrated intervention focus on fractions and decimals improve at-risk students' rational number performance? *Contemporary Educational Psychology, 59*, article 101782. <https://eric.ed.gov/?id=ED595127>

Studies that meet WWC group design standards with reservations

None.

Studies that do not meet WWC group design standards

None.

Studies that are ineligible for review using the Primary Mathematics Protocol

None.

Endnotes

¹National Mathematics Advisory Panel. (2008). Foundations for success: Final report of the National Mathematics Advisory Panel. Washington, DC: U.S. Department of Education.

²The descriptive information for this intervention comes from Fuchs et al. (2013). The What Works Clearinghouse (WWC) requests developers review the intervention description sections for accuracy from their perspective. The WWC provided the developer with the intervention description in March 2019 and the WWC incorporated feedback from the developer. Further verification of the accuracy of the descriptive information for this intervention is beyond the scope of this review.

³The literature search reflects documents publicly available by January 2019. Reviews of the studies in this report used the standards from the WWC Procedures and Standards Handbooks (version 4.0) and the Primary Mathematics review protocol (version 4.0). The evidence presented in this report is based on available research. Findings and conclusions could change as new research becomes available.

⁴During the 5 years of the study, the authors refined and revised *Fraction Face-Off!*. In Fuchs et al. (2013), the authors note that *Fraction Face-Off!* is a revision of Fraction Challenge (Fuchs et al., 2013), where the major difference is that *Fraction Face-Off!* addresses a larger set of skills and is better aligned with the Common Core State Standards than Fraction Challenge. The authors do not provide additional information on the differences between earlier and later versions of *Fraction Face-Off!*.

⁵Depending on the study year, the number of schools varies from 12 to 14. The WWC could not determine whether any of the schools were the same in multiple years.

⁶This review of *Fraction Face-Off!* has the same study ratings as two separate prior WWC reviews of Fuchs et al. (2013), which were conducted under version 2.1 standards, and a prior review of Fuchs et al. (2014), which was conducted under version 3.0 standards. Like the current review, each of these prior reviews resulted in a rating of Meets WWC Group Design Standards Without Reservations. However, the presentation of findings in the prior reviews differ from the current review due to changes in the WWC Standards and Procedures Handbooks (version 4.0) and the Primary Mathematics review protocol (version 4.0). For this review, the two citations from the prior reviews were grouped together as one study using the definition of a study given in the WWC Procedures Handbook (version 4.0), whereas the previous review of Fuchs et al. (2014) did not consider Fuchs et al. (2013) as an additional source. As a consequence of considering findings from all study years as part of a single study, this review combined analytic samples across five cohorts of students. The combined results for eligible outcome measures are presented as the main findings. In addition, the current review combined the two intervention groups each year, which the prior reviews did not do because the prior reviews were individual study reviews that were interested in findings for intervention groups

that differed on any dimension, whereas this review focuses on the effect of *Fraction Face-Off!* when there is variation in implementation. Finally, the current review refers to one outcome as the fraction calculations measure, whereas the prior reviews referred to this measure as the fraction battery-revised assessment. This change came after the authors revised the name of the test over the course of the study.

⁷With the exception of the first cohort, the authors presented results for two arms of the intervention separately with a comparison group. The WWC created a pooled intervention group and compared the pooled group with the comparison group and report it as the main finding of the study for each cohort. The WWC reviewed findings of each individual intervention arm with the comparison group as supplementary findings that are available on the WWC website (<https://whatworks.ed.gov>).

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